

## PATENT COOPERATION TREATY

PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner  
 US Department of Commerce  
 United States Patent and Trademark  
 Office, PCT  
 2011 South Clark Place Room  
 CP2/5C24  
 Arlington, VA 22202  
 ETATS-UNIS D'AMERIQUE  
 in its capacity as elected Office

Date of mailing (day/month/year) 12 January 2001 (12.01.01)	
International application No. PCT/SE00/00229	Applicant's or agent's file reference 99002 UTAP
International filing date (day/month/year) 07 February 2000 (07.02.00)	Priority date (day/month/year) 04 June 1999 (04.06.99)
Applicant ARVIDSSON, Thomas	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:  
 22 November 2000 (22.11.00)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was  
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer R.-E. Stoffel
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
14 December 2000 (14.12.2000)

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(10) International Publication Number  
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(51) International Patent Classification: **E21D 21/00**

Thomas [SE/SE]; Järntorgsgatan 12, S-703 61 Örebro (SE).

(21) International Application Number: **PCT/SE00/00229**

(74) Agent: **GRUNDFELT**, Gunnar; Atlas Copco Rock Drills AB, Patents, S-701 91 Örebro (SE).

(22) International Filing Date: 7 February 2000 (07.02.2000)

(25) Filing Language: **English**

(81) Designated States (*national*): AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

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9902065-3 4 June 1999 (04.06.1999) SE

(71) Applicant (*for all designated States except US*): **ATLAS COPCO ROCK DRILLS AB** [SE/SE]; S-701 91 Örebro (SE).

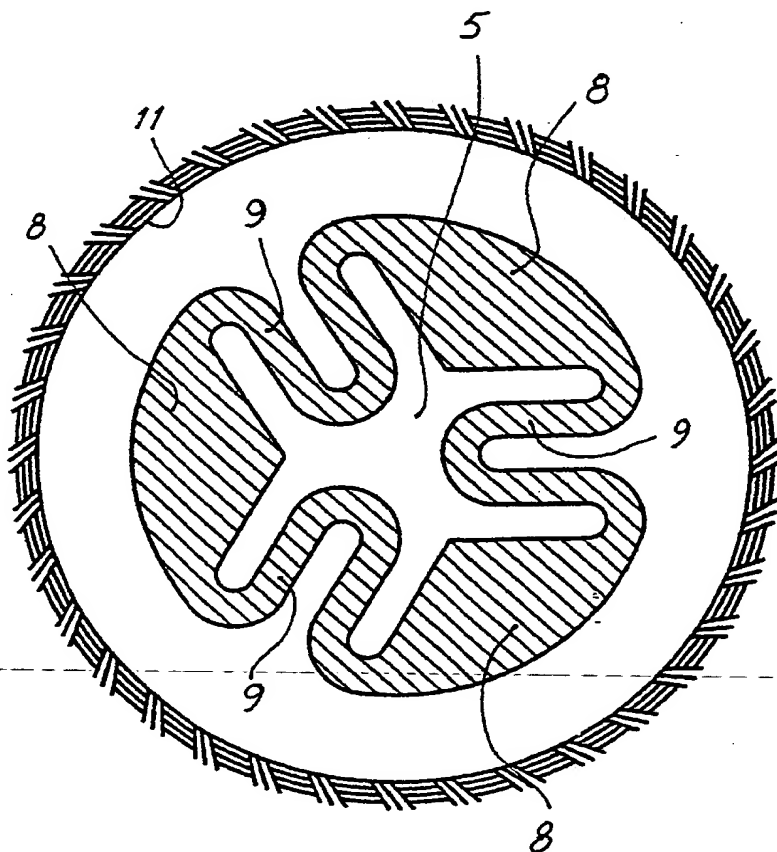
(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

(72) Inventor; and

(75) Inventor/Applicant (*for US only*): **ARVIDSSON**,

[Continued on next page]

(54) Title: **TUBE-FORMED ROCK BOLT**



(57) Abstract: Tube-formed rock bolt with closed profile intended to be anchored in a bore hole. The bolt is anchored in the bore hole through internal pressurisation with a fluid, for instance water, so that its diameter is plastically expanded into contact with the wall of the hole. The bolt has before its expansion a cross-section whose peripheral length exceeds the circumference of the hole but a largest diameter, which is smaller than that of the hole. In order to obtain a profile being sufficiently flexible for expansion and at the same time having a sufficiently large cross-sectional area for the strength the tube has a varying wall thickness in a peripheral direction. This is achieved by making the tube-formed bolt by means of extrusion of an aluminium-based material.

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# INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 00/00229

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: E21D 21/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: E21D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2072784 A (R.W. THOM), 7 October 1981 (07.10.81), page 1, line 30 - line 39; page 2, line 51 - line 54; page 2, line 98 - line 100, figures 1,2, abstract --	1-4
A	US 1410258 A (J. KENNEDY), 21 March 1922 (21.03.22), page 2, line 23 - line 42, figures 1,4, 5,8 --	4
A	US 4284379 A (W.M. CHAIKO), 18 August 1981 (18.08.81), figure 3, abstract --	4

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

\* Special categories of cited documents

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

29 May 2000

Date of mailing of the international search report

06-06-2000

Name and mailing address of the ISA

Swedish Patent Office

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 00/00229

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2234568 A (INGERSOLL-RAND COMPANY), 6 February 1991 (06.02.91), page 3, line 12 - line 14, figure 4, abstract  --	1-4
A	US 4474516 A (E. SCHIEFER), 2 October 1984 (02.10.84), abstract  -- -----	5

# INTERNATIONAL SEARCH REPORT

Information on patent family members

02/12/99

International application No.

PCT/SE 00/00229

Patent document cited in search report			Publication date	Patent family member(s)		Publication date
GB	2072784	A	07/10/81	DE	3111673 A	19/05/82
				FR	2479322 A	02/10/81
				ZA	8101894 A	28/04/82
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US	1410258	A	21/03/22	US	1410259 A	00/00/00
				US	1410260 A	00/00/00
-----						
US	4284379	A	18/08/81	NONE		
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GB	2234568	A	06/02/91	AU	631670 B	03/12/92
				AU	6007190 A	27/06/91
				CA	2022433 A,C	03/02/91
				FR	2650625 A,B	08/02/91
				US	5137395 A	11/08/92
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US	4474516	A	02/10/84	DE	3120809 A	16/12/82
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## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 99002 UTAP	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/SE00/00229	International filing date ( <i>day/month/year</i> ) 07.02.2000	Priority date ( <i>day/month/year</i> ) 04.06.1999
International Patent Classification (IPC) or national classification and IPC <sub>7</sub> E21D 21/00		
Applicant Atlas Copco Rock Drills AB et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of \_\_\_\_\_ sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand  22.11.2000	Date of completion of this report  31.08.2001
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 08-667 72 88	Authorized officer  Christer Bäcknert / JA A Telephone No. 08-782 25 00

## I. Basis of the report

## 1. With regard to the elements of the international application:\*

☒ the international application as originally filed☐ the description:

pages \_\_\_\_\_, as originally filed

pages \_\_\_\_\_, filed with the demand

pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_

☐ the claims:

pages \_\_\_\_\_, as originally filed

pages \_\_\_\_\_, as amended (together with any statement) under article 19

pages \_\_\_\_\_, filed with the demand

pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_

☐ the drawings:

pages \_\_\_\_\_, as originally filed

pages \_\_\_\_\_, filed with the demand

pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_

☐ the sequence listing part of the description:

pages \_\_\_\_\_, as originally filed

pages \_\_\_\_\_, filed with the demand

pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_

## 2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language \_\_\_\_\_ which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).☐ the language of publication of the international application (under Rule 48.3(b)).☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

## 3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.☐ filed together with the international application in computer readable form.☐ furnished subsequently to this Authority in written form.☐ furnished subsequently to this Authority in computer readable form.☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.4. ☐ The amendments have resulted in the cancellation of:☐ the description, pages \_\_\_\_\_☐ the claims, Nos. \_\_\_\_\_☐ the drawings, sheet/fig \_\_\_\_\_5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2 (c)).\*\*

\* Replacement sheets which have been furnished to the Receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

\*\* Any replacement sheet containing such amendments must be referred to under item I and annexed to this report.

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/BE00/00229

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement.****1. Statement**

Novelty (N)	Claims	<u>1-5</u>	YES
	Claims		NO
Inventive step (IS)	Claims	<u>1-5</u>	YES
	Claims		NO
Industrial applicability (IA)	Claims	<u>1-5</u>	YES
	Claims		NO

**2. Citations and explanations (Rule 70.7)**

The documents cited in the International Search Report represent the prior art. The claimed invention stated in claims 1-5 is not considered to be anticipated by these documents. None of the documents or any relevant combination of them reveal a tube-formed rock bolt as described by these claims.

According to the arguments stated above, the invention claimed in claims 1-5 is novel, considered to involve an inventive step and have industrial applicability.





**Published:**

— With international search report.

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

### Tube-formed rock bolt

The present invention relates to a tube-formed rock bolt with closed profile, which is inserted in a bore hole and then expanded into contact with the wall of the bore hole through plastic deformation by means of internal pressurisation.

In a previously known rock bolt, see e.g. US-A-4 509 889, a comparatively thin-walled tube of mild steel is used, which during manufacture is deformed such that its peripheral length is larger than the circumference of the bore hole. A drawback with this formation is that the tube is relatively thin-walled in order to allow deformation against the wall of the bore hole. This gives a comparatively small cross-sectional area, which restricts the tensile strength of the rock bolt. The unsymmetrical form of the rock bolt gives as result that the contact force against the rock varies along the periphery, which limits the load carrying capacity. A further drawback is that the steel material is exerted to corrosion attack.

The present invention, which is defined in the subsequent claims, aims at achieving a tube-formed rock bolt having a substantially higher tensile strength. This is achieved primarily because the rock bolt comprises a tube, which has a material thickness varying along the periphery. Through this one can increase the cross-sectional area of the tube substantially at the same time as one has parts, which are easily deformed so that the rock bolt gets a secure grip against the wall of the bore hole. The advantageous embodiments of the invention given in the subclaims give as results that the rock bolt obtains good corrosion resistance, is easy to manufacture and gives a good contact force against the wall of the bore hole around the hole.

Two embodiments of the invention are described below with reference to the accompanying drawings in which fig 1 shows a tube-formed rock bolt in perspective with one end closure removed in order to show the cross-sectional form. Fig 2 shows a cross section through the bolt according to fig 1 and schematically the surrounding bore hole in which the rock bolt is to be anchored. Fig 3 shows an alternative embodiment of the invention.

The tube-formed rock bolt shown in the drawings comprises an elongated tube 1 provided with two end closures 2,3. In the shown example the end closures are made as caps, which sealingly have been connected with the tube 1. Through this a room 5 is created between the tube 1 and the end closures 2,3. This room can be pressurised via a passage 4 at the end closure 2. The end closures can be achieved in other ways. The essential is that the ends of the tube 1 are sealed so that one through pressurisation of the room 5 can expand the tube 1 to contact against the bore hole 11. The tube 1 is, for instance, made by means of extrusion of an aluminium-based material, e.g. EN-AW 6082-T4. The tube 1 can thereby advantageously be given cross-sectional forms like those shown in figs 2 and 3. By making the profile symmetrical relative to the longitudinal sections 6,7 one obtains a relatively even distribution of the contact force between the tube 1 and the bore hole 11 after expansion of the bolt. One obtains about the same result with the bolt form shown in fig 3. This means that the bolt can be loaded more heavily without gliding in the bore hole. The bolt shown in fig 2 comprises four substantially triangularly formed parts 8, which have large cross-sectional areas and thus large stiffness and tensile strength. These parts are connected by means of U-shaped deformation parts 9. In order to increase the flexibility the tube profile has been provided with a number of circularly formed parts 12 at the deformation parts 9.

When a rock bolt is to be anchored in a bore hole the bolt is pushed into the bore hole with the end closure 3 at the inner end of the bore hole. Then pressure fluid is supplied via the passage 4 to the room 5 surrounded by the tube 1. Through this the tube 1 is expanded so that it contacts the wall of the bore hole 11 hardily. Then the room 5 is unloaded whereby the tube 1 remains firmly anchored, since the previous expansion has deformed the tube 1 plastically.

The invention can, of course, be varied within the scope of claim 1. The profile can, for instance, have more or fewer than four stiff parts. An example of this is shown in fig 3.

## Claims:

1. Tube-formed rock bolt comprising an elongated tube (1), which in a cross section has a peripheral length which exceeds the peripheral length of a circle having a diameter being equal to the largest transverse dimension of said tube, two end closures (2,3) on said tube and a passage (4) at one of said end closures (2,3) for pressurisation of a room (5) surrounded by said tube (1) for expansion of said tube against a bore hole, characterized thereby that said tube (1) has a varying material thickness in a peripheral direction.
2. Tube-formed rock bolt according to claim 1, characterized thereby that said tube (1) is manufactured by means of extrusion.
3. Tube-formed rock bolt according to claim 1 or 2, characterized thereby that said tube (1) comprises an aluminium-based material.
4. Tube-formed rock bolt according to any one of claims 1-3, characterized thereby that said tube (1) is symmetrical about two longitudinal sections (6,7) which are perpendicular relative to each other.
5. Tube-formed rock bolt according to any one of claims 1-3, characterized thereby that said tube (1) comprises a number of substantially triangularly formed stiff parts (8) and intermediate U-shaped deformation parts (9).

1/2

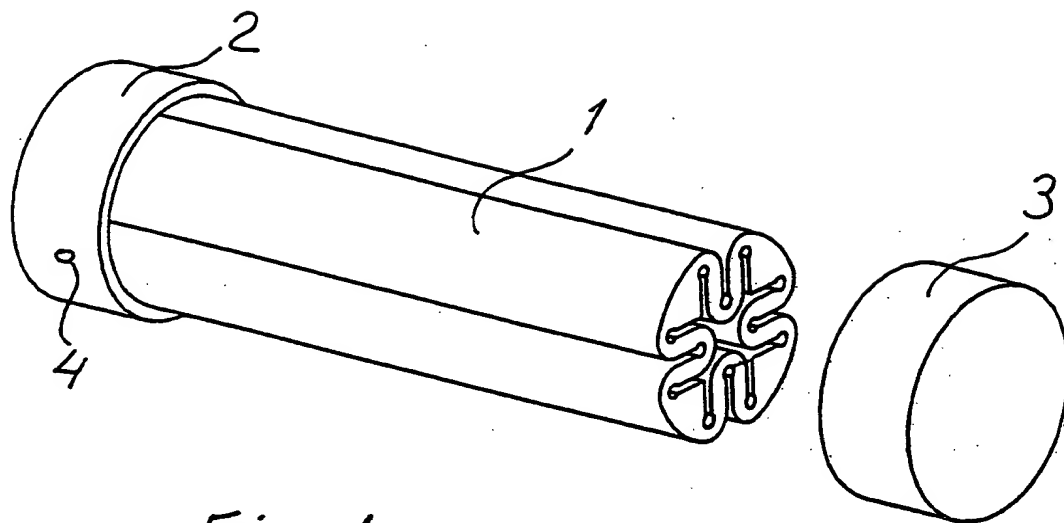


Fig. 1

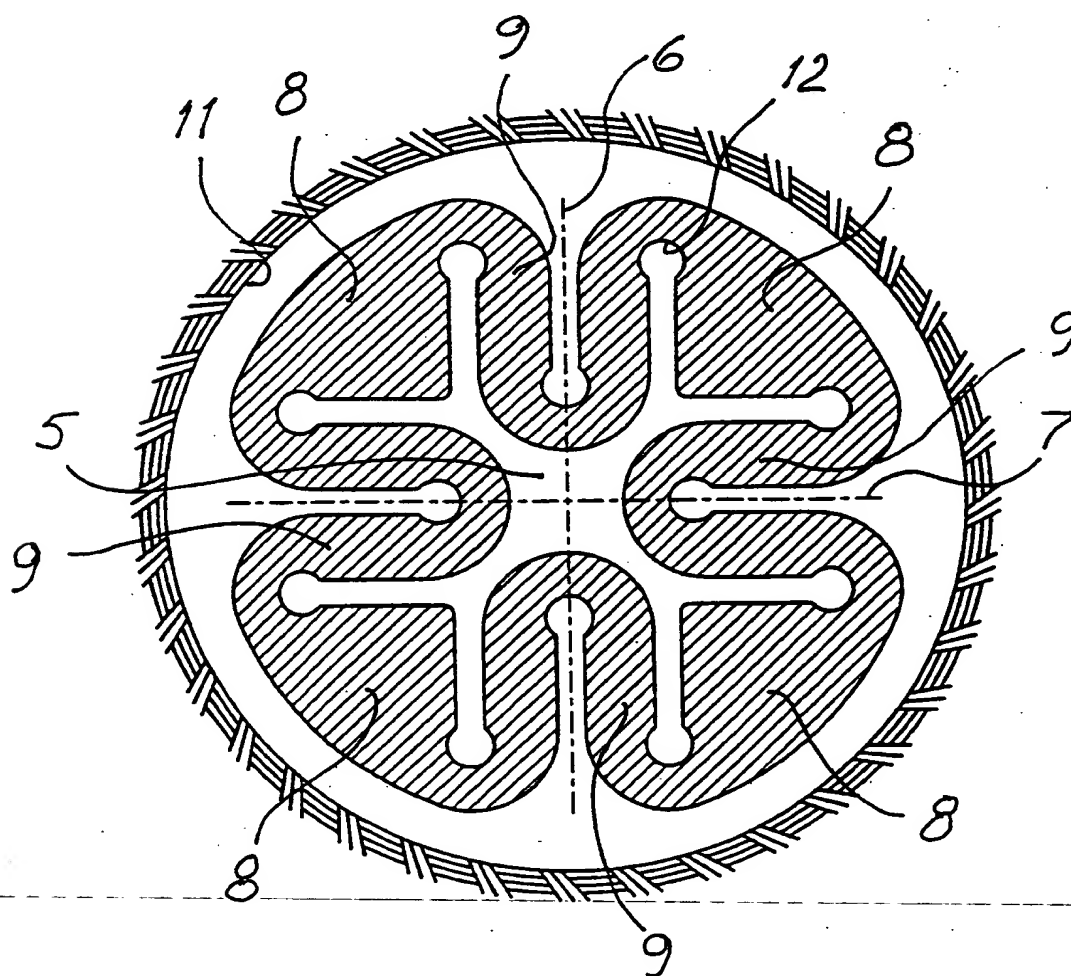


Fig. 2

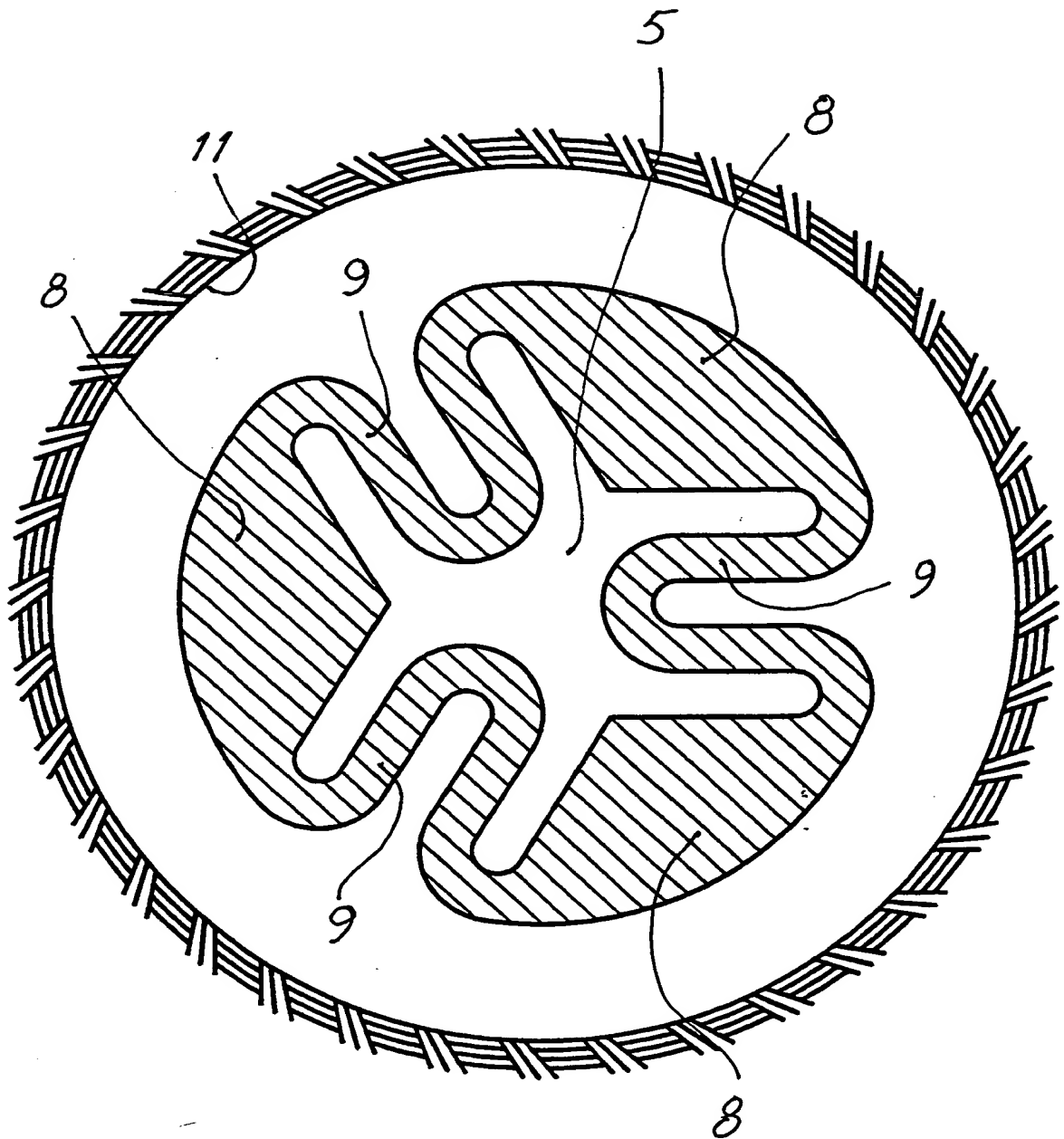


Fig. 3

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 00/00229

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: E21D 21/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: E21D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2072784 A (R.W. THOM), 7 October 1981 (07.10.81), page 1, line 30 - line 39; page 2, line 51 - line 54; page 2, line 98 - line 100, figures 1,2, abstract --	1-4
A	US 1410258 A (J. KENNEDY), 21 March 1922 (21.03.22), page 2, line 23 - line 42, figures 1,4, 5,8 --	4
A	US 4284379 A (W.M. CHAIKO), 18 August 1981 (18.08.81), figure 3, abstract --	4



Further documents are listed in the continuation of Box C.



See patent family annex.

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"E" earlier document but published on or after the international filing date

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Date of the actual completion of the international search

29 May 2000

Date of mailing of the international search report

06-06-2000

Name and mailing address of the ISA

Swedish Patent Office

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Authorized officer:

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Telephone No. +46 8 782 25 00

International application No.  
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**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

02/12/99

International application No.  
PCT/SE 00/00229

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2072784 A	07/10/81	DE 3111673 A FR 2479322 A ZA 8101894 A	19/05/82 02/10/81 28/04/82
US 1410258 A	21/03/22	US 1410259 A US 1410260 A	00/00/00 00/00/00
US 4284379 A	18/08/81	NONE	
GB 2234568 A	06/02/91	AU 631670 B AU 6007190 A CA 2022433 A,C FR 2650625 A,B US 5137395 A	03/12/92 27/06/91 03/02/91 08/02/91 11/08/92
US 4474516 A	02/10/84	DE 3120809 A	16/12/82